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Keywords
Conservation; conflicts; game theory; experimental games; constructivist games; role-playing.

Highlights (two to four)
See conflict games highlights.doc

Abstract (100 - 120 words)
Conservation conflicts represent complex multi-layered problems which are challenging to study. We explore the utility of theoretical, experimental and constructivist approaches to games to help understand and manage these challenges. We show how these approaches can help develop theory, understand patterns in conflict and highlight potentially effective management solutions. The choice of approach should be guided by the research question and whether the focus is on testing hypotheses, predicting behaviour or engaging stakeholders. Games provide an exciting opportunity to help unravel the complexity in conflicts, whilst researchers need an awareness of the limitations and ethical constraints involved. Given the opportunities, this field will benefit from greater investment and development.

The conflict challenge

Conflicts are widespread within conservation and are damaging to both conservation interests and to the livelihoods and well-being of people involved [1,2]. Such conflicts are often complex, seemingly intractable and open-ended “wicked” problems [3–5]. Whilst superficially they may appear to be about lions attacking livestock, or the impact of superabundant geese in an agricultural landscape, in reality they involve complex layers of multiple stakeholders with different interests, values, goals, and life experiences in different political, cultural and historical settings [2,6–9]. The complexity of conflicts challenges our ability to tease out critical elements, understand the dynamics of conflict and stakeholder behaviour, design effective interventions, understand how to promote engagement and build possible solutions. Traditional approaches to studying such issues have often failed to meet this challenge and in some cases have led to ineffective interventions which at worst can exacerbate existing problems [10].

Games offer a potentially powerful means to disentangle this complexity and help understand conflicts and their management. In everyday usage, a game is a competitive activity defined by its rules, and is generally played for fun. However, a more formal definition is offered by game theory, which regards a game as a model of a strategic situation in which the outcome of an individual’s action also depends on the actions chosen by others[11,12]. Viewed in this way, games provide both a framework for formal analysis of conflicts and form the basis of a set of powerful research tools which can be used to clarify the key elements of a conflict, investigate

74 the beliefs and behaviour of the participants, examine the effects of changes to the
75 system and engage stakeholders in productive discussion.
76
77 Various approaches to studying conflict and co-operation based on games have been
78 developed in fields related to conservation [13–17], but the games literature can
79 seem a bit overwhelming: the characteristics, strengths and weakness of alternative
80 approaches are not always clearly understood; they have different philosophical
81 underpinnings; and the terminology used to describe them can be confusing for non-
82 specialists. As a result, they have not yet been widely applied to the study of
83 conservation conflicts.
84
85 We cannot hope to be comprehensive in reviewing the diversity of games here, so
86 instead we focus on describing and differentiating between theoretical,
87 experimental and constructivist approaches to using games that are relevant to
88 those working in conservation. We explore how each one may contribute to our
89 understanding and management of conflict. We start by briefly describing and
90 illustrating the approaches with examples. We then consider the types of problems
91 that emerge in conflict situations and how they may be addressed by the different
92 approaches to games. From there we examine an on-going conflict to illustrate how
93 games may help to understand and manage it. Lastly, we consider some of the
94 general limitations and ethical issues involved in using games in conflicts and
95 propose promising directions for future work.
96

Approaches to games

Theoretical games are characterised by a formal mathematical analysis or simulation of players, behaviours, outcomes and rules (see Box 1). They are useful for understanding the nature of conflicts and identifying novel solutions to real-world situations of strategic conflict. For example, a typical situation concerns the joint goals of wildlife conservation and food production where protected animals have a negative impact on farmers. Such a scenario could be simplified to consider two possible strategies - for parties to cooperate, or to defect as when farmers illegally hunt or conservationists exclude local people from the benefits of tourism income. Game-theoretic analyses of such simple scenarios often seek analytic solutions [18]. For example, in the "tragedy of the commons" scenario [19], individuals seek to maximise their own payoffs, leading to long term reductions in benefits for everyone (all wild animals killed and no income from tourism). Because this problem is defined by strategic interactions among rational players, a game-theoretic perspective can be used to better understand such conflicts and potentially offer novel solutions for promoting cooperation and sustainability [20,21], such as having an agreed level of wild animals, agriculture and income from tourism.

In the related fields of common pool resources, land and water management and fisheries, theoretical games have included more complex dynamic simulations, the coupling of social-ecological systems and the uncertainty that is inherent in these systems. The inclusion of both natural resource dynamics and human behaviour has improved our conceptual understanding of conflict situations [22–24], broken down the complexity of decision-making for individual stakeholder objectives [25], allowed

us to make qualitative or quantitative predictions of behaviour or other system outcomes [26] and unified case studies through common theory [20,27]. Theoretical games typically assume that simulated players follow a particular set of behaviour patterns, such as being rational decision-makers, providing a baseline for comparison with real-world behaviour [12]. However, behaviours deviating from classical economic theory are also possible [28,29]. For a detailed discussion of the use of game-theoretic approaches in conservation see [23].

Strengths: Useful to probe theoretical understanding of a situation, examine the logical conclusions of assumptions about a conflict, and make predictions about the effects of changing aspects of a system.

Weaknesses: Necessarily simplified; they cut humans out of the loop, so the complexity of real people in the process is lost.

Experimental games are used to investigate participant behaviour in controlled strategic situations, in either the laboratory or the field [30]. Experiments based on games provide powerful tools for testing theoretical predictions about individual and group behaviour [31] and for quantifying behavioural traits, such as levels of trust and trustworthiness [32] and preferences for risk or fairness [33]. In this way, experimental games enable the investigation of responses to conservation interventions within the context of complex social dilemmas without the need to rely on theoretical assumptions, or expensive full implementation studies. They are well suited to investigations of possible conflict management strategies, enabling researchers to study their relative effectiveness in a controlled setting prior to implementation (See Box 2). This approach is particularly useful when participants in

145 a game are themselves stakeholders in the conflict the game seeks to model since
146 behaviour has been shown to vary with factors such as cultural and educational
147 background and familiarity with the situation being represented [34]. The application
148 of experimental game approaches with real stakeholders thus increases the
149 likelihood that results of experiments are applicable to real world resources,
150 institutions, and people [31].
151 *Strengths: Useful for testing theories and practical interventions that would be*
152 *difficult, expensive or unethical to test at 'reality scale' and to quantify behavioural*
153 *traits.*
154 *Weaknesses: Necessarily simplified, although not as much as theoretical games;*
155 *Design and implementation requires attention to detail so that a truly fair*
156 *comparison is made among treatments. Outcomes can be sensitive to small changes*
157 *in the experimental design.*
158
159 *The constructivist* approach requires games to be designed and used in iterative
160 processes to understand conflict situations and to help stakeholders come up with
161 solutions [35]. These games can be card games, board games or role-playing games,
162 and they are used to foster dialogue and build trust among stakeholders [36]. As for
163 experimental games, constructivism integrates players inside the game – bringing in
164 their needs, desires, beliefs and intentions, allowing their behaviour in the game to
165 represent differences in knowledge and values. The difference from other
166 approaches, however, is that here the players are given freedom to explore a range
167 of possible outcomes in strategic situations, so they can reframe the problem and
168 the game, and create new options not initially contemplated by the research team

169 [35](Box 3). As a result the capacity to learn and anticipate are integral to the
170 behaviour observed within a game [37]. In conservation conflict contexts, these
171 games often have a multi-agent system structure, with a landscape, resources, and
172 stakeholders, interactions within and among these components, and explicit
173 representation given to the cognitive capacities of the agents [38]. This approach is
174 exemplified by the work of the Companion Modelling community
175 (www.commod.org).
176 ***Strengths****: Flexible enough to allow for a wide range of human behaviour; useful to*
177 *establish dialogue, help people understand different viewpoints and agree a shared*
178 *understanding of a conflict.*
179 ***Weaknesses****: Documentation, analysis, replication and synthesis are all challenging.*
180

181 ## How can games be used to address questions about conflicts?

182 A number of issues that emerge from research on conflicts are pertinent to games
183 [2] (Table 1). First, there is a need to find generalities from the numerous case
184 studies and build relevant theory. For example, we might want to develop
185 hypotheses for how cooperation can develop in dynamic ecosystems that typically
186 have a high degree of uncertainty and significant fluctuations in resources [39].
187 When mapping conflicts, there is a need to explore the underlying patterns and
188 behaviour of conflicts – how they emerge and how they change over time, and when
189 they switch from conflict to cooperation [40,41]. In addition, understanding conflict
190 relies on mapping the underlying stakeholder values, emotions, interests and
191 positions and how these aspects affect behaviour in conflicts [42–46]. Moving into
192 conflict management, a widespread issue lies in understanding the impact of

different types of interventions on stakeholder behaviour and on the level of conflict. Such interventions can include both specific technical measures such as compensation schemes or lethal control, or interventions focused on trust and relationships, dialogue processes, governance and institutions [47–55]. Lastly, a critical issue lies in the importance of dialogue and engagement in promoting listening, understanding and the development of solutions among stakeholders.

All three approaches to using games can provide useful insight into each of these areas of conflict research (Table 1), and the choice between them should be guided by the specific research question and context in which they will be applied. However, some approaches tend to suit certain objectives. For example, experimental approaches are well suited to exploring how an intervention might alter stakeholder behaviour in a conflict, whilst constructivist approaches are useful when exploring solutions with stakeholders. It is also worth pointing out that synergies can arise by using combinations of games, such as experimental and constructivist approaches [56].

To further guide the choice of approaches, it is useful to ask whether the main aim of the game is to test specific hypotheses, predict behaviour or to engage stakeholders (Figure 1).

Approaching a live conflict – geese in agricultural landscapes

To illustrate the utility of alternative approaches, we consider how games could be used to illuminate different facets of the conflict over rapidly increasing geese

populations (Box 4). Most populations of geese in Europe (14 of 17 populations of 7 species) have grown from threatened to super-abundant over the last 60 years [68]. These geese often graze in intensively managed agricultural fields leading to conflict with farming objectives [69,70]. Management strategies and policies have failed to adapt to this increasing problem, causing frustration among stakeholders, and reinforcing polarisation and conflicts [71]. Games can provide insight into the understanding and management of this conflict in several ways.

General limitations & ethics

Games have enormous potential to provide insight, but they are not a panacea. One of the main limitations is that, as for all models of reality, they simplify complex situations and it is hard to choose which aspects of a situation can be safely ignored. In addition, games can give the illusion of representing real-world outcomes, yet they cannot predict with certainty what will happen when the stakes are real. A particular concern about external validity arises in situations where the payoffs used in a game are considerably lower than in real-life [31,72]. Similarly, there are issues of internal validity - are the decisions being made by game participants the same as those a researcher believes are being made? [72]. These questions need to be considered throughout the process of developing, implementing and interpreting a game. Debriefing sessions after experimental and constructivist games with the participants are valuable in helping address these issues.

While games can seem innocuous fun, when played with stakeholders they can raise serious ethical issues: from framing and game design through implementation and publishing the results. For example, at the design stage, it is easy for researchers to plan a game in such a way that the outcome of the game into a foregone conclusion. To avoid this pitfall, the community of Companion Modelling has drafted a charter of conduct [35]. In addition, early and thorough testing is essential. Game designers need to consider how to capture and represent sensitive behaviours, such as corruption, poaching or reprisals. Designs and tools are available to avoid revealing individual information to other players, or even to the research team [73]. Stakeholders might also question whether games are serious enough to warrant the interest of busy professionals with a reputation to lose [37].

Payments involving cash or other tangible goods are sometimes used in games [73,74]. These approaches need to be thought through before implementation. Payments linked to individual performance within games are supposed to give players an incentive to focus harder, but also incentivise acting more selfishly, potentially undermining the basis of collaboration [75]. In certain contexts, this would improve understanding of the system. In others, it could be detrimental, particularly if the incentives are trivial compared to the costs that stakeholders incur in real life.

During certain games, the role of the participants will evolve, and researchers need to reflect on how much power they are willing to give to participants and how to deal with the power asymmetries among stakeholders and between stakeholders

and the research team [76]. In fact, even playing a game can affect the system, so researchers need to exercise reflexivity to be aware of any potential unintended outcomes of such interventions [67,77]. Games with participants can also spark conflicts but these are generally inherent to the situation being explored. Games simply bring these processes to light so that the conflict can be managed instead of being suppressed by the power structure of the status quo [78]. Nevertheless, they require careful facilitation to manage expectations and deal with emerging issues.

The ethical considerations of publishing games that involve stakeholders are also important. Participants should be informed how data will be used, who will have access to it, and in what form, particularly if it is identifiable to a particular player. As with other empirical approaches to investigating sensitive behaviour, anonymising individual behaviour might not, in itself, be sufficient to ensure that game participants are protected from harm [79].

Future Directions

Games offer exciting opportunities to help guide the understanding and management of conflicts over biodiversity and conservation. This field of conflict research is focused on case studies with limited efforts to draw out the generalities [80]. Games have the potential to help find and explore the generalities, such as the consistent findings in ultimatum games of concern for others – as opposed to the pure self-interest that is often assumed [11] and consider how they might fit in different contexts. We consider a number of outstanding questions in Table 2.

Concluding remarks

Conflicts are ubiquitous, persistent and damaging. Their complexity and critical human dimensions mean that they are challenging to study and manage. Games have the potential to address these problems and provide genuine insight into a wide range of issues around how we understand and manage conflicts. Moreover, games also have the potential to be fun. There are different types of games available to address different questions and situations – from theoretical games to ones involving the active participation of stakeholders. Given their potential to help develop theory, understand patterns in conflict and highlight potentially effective management solutions, we suggest this field is ripe for development, given proper awareness of the limitations and ethical constraints.

Box 1 An example of a theoretical game developed to address a fisheries conflict and the role of cooperation.

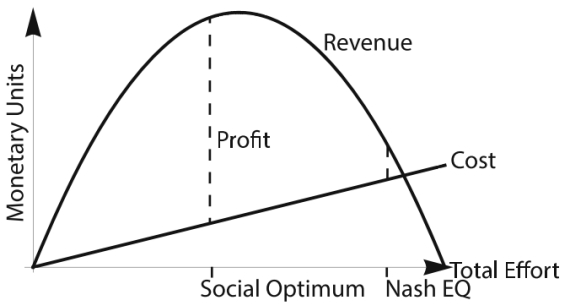

Figure 1 from [19] showing that cooperation and ultimately sustainability is best promoted at a higher total effort of harvest (Nash EQ) than would be optimal (Social Optimum) for maximising long-term profit (dashed lines). Figure reproduced with permission from the journal.

Tilman et al. [24] recently investigated conflict within a social-ecological fishery system by constructing a mathematical model of the fishery as a common-pool resource system. Fishers can increase their own profits by maximising their catch, but the individual gain achieved by doing so contributes to long-term depletion of total fisheries stock. The authors looked at this case study using game theory, defining a 'socially-optimal' fishing strategy that could be enforced by allowing fishers to ostracise one another when over-harvesting occurs. In the mathematical model, fishers could either join a cooperative or they could harvest independently which increased profit, but came at the cost of being ostracised by the cooperative. Further, the punitive power of the cooperative increased with its size, and ostracising independent harvesters also incurred a cost to the fishers in the cooperative.

Tilman et al. [24] modelled the dynamics of fish biomass and the fraction of fishers that joined the cooperative. Fishers were assumed to be rational agents who joined or not based on whichever choice maximised their profit. They demonstrated the conceptually general, counter-intuitive result that social ostracism can promote cooperation and ultimately sustainability when individuals within a cooperative harvest at a rate that is higher than what would otherwise be optimal for maximising the long-term rate of resource harvest overall. This is because a higher harvest rate for individuals within a cooperative can discourage independent harvesters from invading, and ultimately leads to more sustainable long-term harvests. Hence, this theoretical approach suggested a novel, generally applicable, way to address conservation conflict.

Box 2. An example of an experimental game developed to predict the outcomes of incentive-based interventions on illegal resource use in Cambodia.

Photos by H. Travers

In Cambodia, illegal resource use inside protected areas is common, with high rates of hunting and land clearance in particular leading to conflict between local people and conservation authorities. One solution that has been developed to mitigate this conflict is the introduction of incentive-based interventions to promote compliance with land use and resource access zones. To evaluate the potential behavioural impact of these interventions, Travers et al. [65] used an experimental game adapted from the common-pool resource game developed by Ostrom *et al*. [20]. To aid understanding, the game was framed around the harvesting of fish from a pond within the protected area. Each participant was given the option of harvesting fish from this pond or choosing to leave fish unharvested for future use. Payoffs were set such that harvested fish were worth considerably more to the individual harvesting than if they had been left in the pond. However, the collective value of fish left in the pond was greater than the payoff an individual received from harvesting. This set up a social dilemma in which the optimum strategy for players who wanted to maximise their own payoff was to harvest as many fish as they could, whereas the social optimum was to leave all fish in the pond.

A number of alternative management strategies were investigated, including fines if participants were caught harvesting too many fish and individual or collective rewards for keeping harvests within predefined thresholds. The most effective interventions at reducing fish harvest were those that encouraged participants to self-organise, through the use of incentives that were conditional on group behaviour or allocated to individuals by the group. Although the treatments considered in the game were stylised versions of those applied in reality, the findings provided valuable insight into the features of incentive initiatives predicted to have the greatest impact on encouraging sustainable use of resources and mitigating conflict between local people and conservation authorities. This has led to increased efforts to promote the development of local institutions and the provision of collective incentives to local communities.

Box 3. An example of a role-playing game to explore the likely influence of policy change on an agro-forestry system in India

Photos by C.A.Garcia

The landscape of Kodagu, in India's Western Ghats is a mosaic of rice fields, forest fragments and coffee farms. Coffee is produced under complex, multi-storeyed agroforestry systems, but farmers are replacing a diverse, native canopy cover with the fast growing, introduced Silver Oak *Grevillea robusta* [85,86]. Whereas the harvesting of native species is controlled, silver oak can be logged and traded [87]. For years, coffee farmers and their representatives have been demanding full ownership rights over trees on their land [85]. These demands have been opposed by the Forest Department for fear of the environmental impact. Farmer representatives have denied that the granting of rights would result in a loss of tree cover or conversion [88]. This polarized debate has led to a long-lasting standoff.

A role-playing game was developed with academics, representatives of the Central Coffee Board of India, local conservation organisations, private coffee trading companies, and community leaders in eight separate workshops across the district. Through workshops and interviews, the game was co-constructed and explored two scenarios. The business as usual scenario had rules for selling native trees mimicking the restrictions in place. The tree rights scenario saw these restrictions lifted. These game sessions were recorded and used as a basis for discussion.

The results suggested that farmers would increase their income were they to receive full rights. But we also observed that in such situations they decided to hasten, rather than reverse, the conversion to Silver Oak. This strategy was contrary to expectations that farmers would retain native forest, but instead, the faster rotation of Silver Oak trumped the multiple values of the native trees.

The lessons from this role-play game were bittersweet. The game revealed system components and processes that had been identified in none of the policy narratives of the concerned parties. These represented hidden pitfalls that would have plunged the system into a non-desired state had the current policy change been implemented as initially designed. However, these lessons could not be transferred to the policy process, in part because the findings undermined the initial position of our main partners, the coffee farmers themselves.

Box 4. Examples of how three approaches to games could be used in a current conflict over geese impacts on agricultural systems in Sweden.

Background. Increasing numbers of protected geese in Europe are causing impacts on agricultural production [68]. In Sweden, the government pays compensation and supports the scaring of most goose species, but as populations increase, farmers are asking for more lethal control.


Photo by Johan Månsson

Theoretical game example. Objective – *predict the impact of management strategies on collaborations and goose populations.* First, map the time series of goose numbers, management actions and players' interactions over time, to develop a modelling framework within which game theory can be applied. Then simulate the actions and players' interactions using mathematical or computational techniques to find actions that reduce conflict. Such a game could enable predictions as to which actions will lead to collaboration and a sustainable goose population under changing conditions of governmental budget changes.

Experimental game example. Objective – *test a hypothesis that farmers are more likely to cooperate in a goose management scheme, which uses a lethal rather than non-lethal control method*. The game setting would be an idealised landscape in which geese move among farms and damage crops. Players would be farmers who choose between lethal or non-lethal measures using a cash endowment they receive in each round. These measures would only be effective if the sum of investments reached a predetermined threshold. If too few invest, no protection would be achieved. Such an approach would allow researchers to test players' willingness to participate in different measures and examine the effect of collective discussions on individual decision-making. Post-game debriefing sessions would provide a greater understanding of the factors influencing farmer behaviour.

Constructivist games example. Objective – *engage stakeholders to explore lethal vs. non-lethal interventions under changing economic resources*. This game would be played over a co-developed idealised landscape. Stakeholders would build and play the game to explore the strategies they would employ under lethal and non-lethal action scenarios, interacting with each other and the resources in the landscape. The game would allow the compatibility and sustainability of actions over space and time to be assessed. The design and gaming process and post-game reflections would facilitate a shared understanding of the conflict among participants, enabling an explorations of the outcomes and stakeholder acceptance for measures and the development of innovative interventions.

Acknowledgements

SR is grateful for the King Carl XVI Gustaf guest professorship that funded the workshop and allowed him to write this paper. We thank the Swedish EPA for supporting JF, LN and JM.

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Table 2. Outstanding questions

1) How to scale up to the management of a large scale conflict?

Experimental and constructivist games are often played with a relatively small sample of the population of interest, we need to understand how best to scale-up. One approach is to run games with decision-makers, to provide them with the insight into the system and its management. Alternatively, one could run games with trainers, so that they can then play the game more widely with key stakeholders. Digital games also offer one way of extending the reach of these approaches [81,82].

2) How does one win a conservation conflict game?

All games define the winning conditions precisely: eg last man standing, or first one to achieve a certain amount of points. Given the complexity inherent to conservation conflicts, it is likely to be insufficient to only consider the monetary payoffs of different actions because the players may have conflicting interests that cannot be measured using the same unit of pay-off. For example, the value of a lion saved from being killed to conservationists in the USA cannot be easily compared to the value to a farmer of livestock lost to a lion. Other attributes, such as safety, reputation, and symbolic values are also important. To accommodate non-monetary attributes, we need to go beyond the ordinal rankings of pay-offs [22,23] and consider new approaches to determining pay-offs, such as integrating multi-criteria decision analysis and scenario planning analysis [25,83].

3) How to address uncertainty in pay-offs in conservation conflicts?

Predicting people's decision making under increasing uncertainty is paramount for future conservation and conflict management [84]. Game-theoretic approaches in conservation have mostly focused on the mathematical analysis and have so far ignored the dynamic nature of ecosystems (e.g. weather differences between years) and thus the uncertainty in pay-offs these dynamics create [23]. Yet games offer the potential to explore how people respond and change their behaviour according to implementation uncertainty, such as associated with conservation policies or incentives, or in situations of process uncertainty, such as a rapidly changing world. An important advantage of games is that these uncertainties are not tested for each person in isolation but in direct interaction with other players in the community. Games could be set up so that players experience challenges associated with agricultural food shortage or the international protection of species that provided traditional sources of wild meat, thereby mimicking situations of conservation conflict [59].

Figure

Figure 1. Decision tree highlighting the situations under which the different approaches to games are favoured. Experimental approaches are a good fit when addressing the objectives in Table 1 through testing hypotheses, and constructivist approaches are best suited when addressing the objectives through engagement. If the aim is to address the objectives through making predictions about future behaviour, then the most appropriate approach will depend on two things: first, whether or not there is a reasonable model of the players' decision-making process, and second, whether the main interest is in the system or the stakeholders. If there is knowledge of how people choose between a small set of actions then theoretical games will be most useful for predicting the behaviour of both systems and stakeholders. However, if there is no reasonable model of decision-making, then constructivist approaches are likely to be most helpful at predicting system behaviour, and experimental games are likely to be most helpful at predicting stakeholder behaviour.

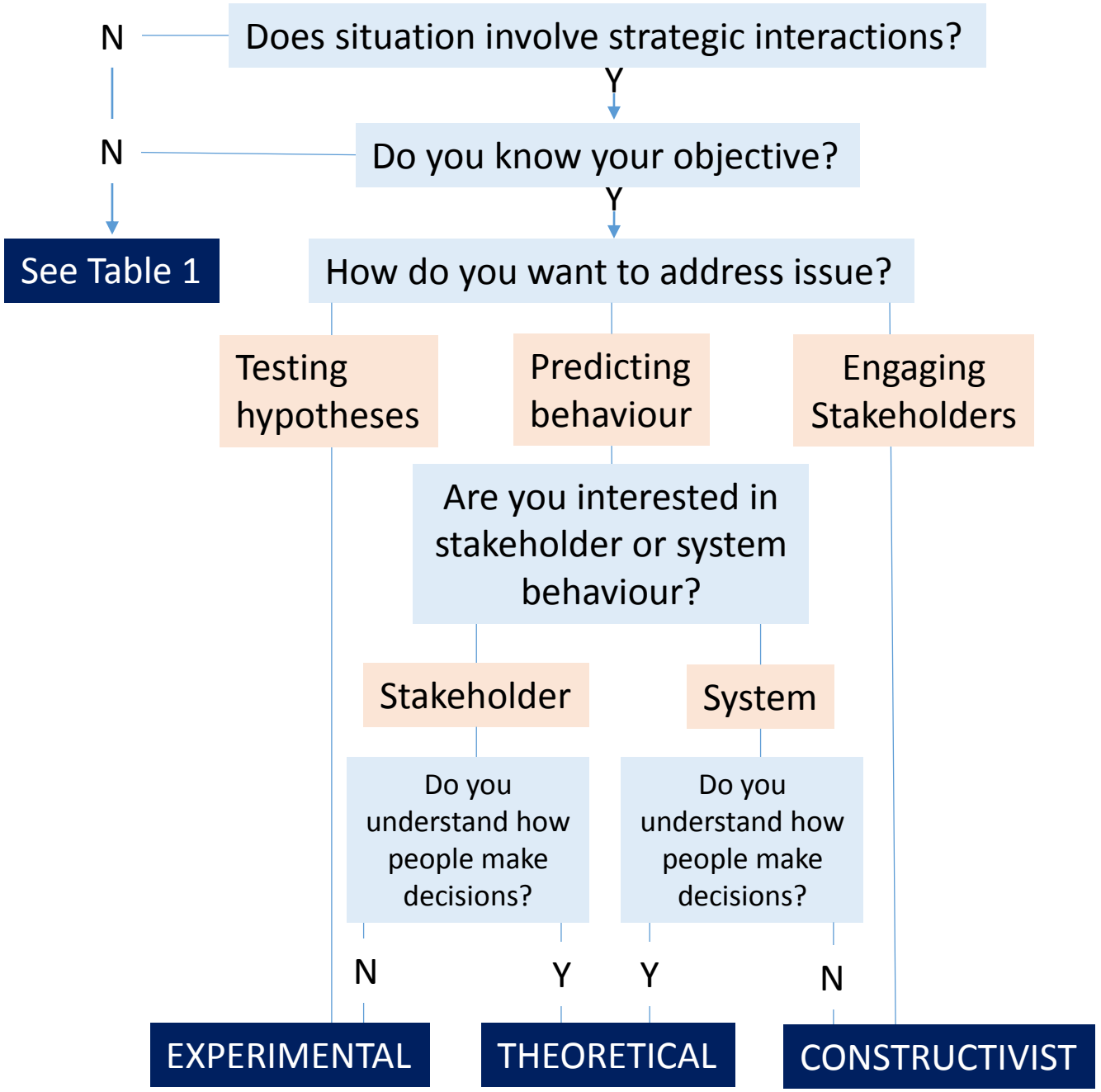

Table 1: Suggestions about how different approaches to games could be used to address objectives relevant to understanding and managing conservation conflicts. These suggestions are illustrative in nature and are not intended to be exhaustive or mutually exclusive. Each suggestion is accompanied by a reference to a study where this type of approach to games was used to address comparable objectives in a related field.

	Approach		
Objective	**Theoretical** e.g. game theoretic mathematical or computer simulation modelling	**Experimental** e.g. common pool resource and public goods games in lab and field	**Constructivist** e.g. role playing games and companion modelling in lab and field
Develop theory about conservation conflict in a changing environment	*Relevance of approach:* To explore the logical consequences of theories of conflict *Comparable example:* Exploring whether social ostracism can promote cooperation and sustainability in fisheries harvesting, assuming rational agents [24] (Box 1).	*Relevance of approach:* To test assumptions about behaviour in conflicts and look for generalities *Comparable example:* Testing how environmental stochasticity and trust affect cooperation to mitigate climate-change [57].	*Relevance of approach:* To elicit the insights of stakeholders about the nature of conflicts *Comparable example:* Eliciting stakeholders' reported behavioural strategies in a natural resource management and conservation setting [36].
Understand how conflicts emerge, evolve and resolve	*Relevance of approach:* To examine the conditions under which conflicts are likely and suggest how they might be changed to encourage cooperation. *Comparable example:* Analysing the history of environmental conflict, identifying the structure and actions (e.g. enforcement) of the conflict and predicting possible solutions [58].	*Relevance of approach:* To test the role of specific factors in promoting cooperation or conflict *Comparable example:* Testing the effects of fear and environmental uncertainty on co-operation between nations with respect to climate change action [59].	*Relevance of approach:* To support dialogue and shared learning to co-identify the roots of and solutions to conflict *Comparable example:* Building a shared representation of farmers' interactions with a protected area to allow for the negotiation of uncertainties and risks [60].
Understand how values, interests and positions affect stakeholder behaviour	*Relevance of approach:* To predict conflict from values and norms *Comparable example*: Predicting the effect of a social norm of fairness on forest conservation [61].	*Relevance of approach*: To test how individual and institutional characteristics affect behaviour in conflicts Comparable example: Investigating how personal norms and other individual characteristics influence cooperative behaviour amongst fishermen [62].	*Relevance of approach*: To facilitate understanding of behaviour and social learning in conflicts. Comparable example: Revealing the processes leading to overgrazing and providing a platform for sharing stakeholder views, knowledge, and perceptions [63]
Identify how interventions affect stakeholder behaviour and conflict	*Relevance of approach:* To predict behavioural responses to different interventions Comparable example: Investigating effects of payments and sanctions on poaching and importance of individual-level heterogeneity	*Relevance of approach:* To test behavioural responses to different interventions *Comparable example*: Investigating the effect of incentive based payments on stakeholder behaviour amongst	*Relevance of approach:* To explore behavioural responses to different interventions with stakeholders Comparable example: Revealing the effect of policy change on stakeholder behaviour in coffee plantations (Box 3)

	and strategic decision-making in design of interventions. [64]	fishermen in Cambodia. (Box 2) [65]	
Promote engagement amongst stakeholders to understand conflicts and develop solutions.	*Relevance of approach:* To explore possible outcomes of conflict under different scenarios Comparable example: Simulating fishery management in order to explore effectiveness of management options with stakeholders [66].	*Relevance of approach:* To encourage reflection by participants, promote dialogue and test solutions Comparable example: Encouraging communities to reflect about the incentives and strategic interactions that can lead to conflict over resource use [67]	*Relevance of approach:* To promote and support co-management Comparable example: Bringing local communities and protected area managers together to support the collaborative production of effective management plans. [60].